

## **Specification**

PET resin mold processed goods

### **Background of the invention**

#### **Field of the invention**

[0001] This invention relates to mold processed goods utilizing PET resin.

### **Description of the Prior Art**

[0002] Conventionally, material for resin were PC (polycarbonate), PP (polypropylene), PE (polyethylene), PS (polystyrene), and PET (polyethylene terephthalate) was not suitable for resin material for injection molding method due to its bad fluidity (in molding). Therefore although PET had good features such as transparency and shockproof property, PET was used in limited areas in flat plate processing such as blister packs and PET bottles using vacuum mold or blow mold processing methods. The injection mold with PET material is possible to some extent with temperature management of gate and the mold shape (for example, refer to Patent Document 1). Also, there have been modifications done onto PET resin to improve its transparency and heatproof property (for example, refer to Patent Documents 2, 3, 4 and 5).

[0003] Recently, there have been some proposals of PET resin material that has improved properties of fluidity, shockproof, transparency and heatproof features (for example, refer to Patent Document 6 and 7).

[0004] Patent Document 1

Patent publication 6-846

Patent Document 2

Patent publication 8-309833

Patent Document 3

Patent publication 7-171868

Patent Document 4

Patent publication 2000-302114 (P2000-302114A)

Patent Document 5

Patent publication 11-105059

Patent Document 6

Patent publication 2003-48967 (P2003-48967A)

Patent Document 7

Patent publication 2003-64167 (P2003-64167A)

[0005] There have been no proposals for products made of PET resin with hinges made of solid mold method.

[0006] Majority of containers for medical apparatuses are made of PP, PS, or of PE resin, but PS goods are easy to break, and PE goods lack transparency. It is a usual practice that sterilized goods are wrapped with external packaging or to have double wrap packaging.

[0007] Majority of containers made from transparent resin in mold processing are made of PC, PP, PS or of PS, and many of the main part of disposable physics and chemistry experiment apparatuses are made of these resins, and lids of these apparatuses are made separately.

[0008] As for slide glasses, there are no resin ones but only glass ones due to transparency and price. There are no sterilized slide glasses.

[0009] Lens, lens frames and side frames are made of resin, but there are no spectacles made of solid mold processing where the parts are made from one mold.

[0010] Vertical joint glass needs to have the center to be sealed after caulking with silicon and such. Expensive processing is necessary when deformed wave and other patterns and designs, characters are to be processed onto a window glass.

[0011] As for light shades and tableware, most are disposable made of PS or PP when made of resin.

[0012] There have been no resin roof tiles made of PET resin material, and there are

no transparent roof tiles.

[0013] There have been no PET resin material utilized in resin made helmets, and there are no transparent helmets.

[0014] The material of PC is expensive, and is not suitable for affordable mass production goods. Although the hardness is assured, PC material is easy to break when made into thin plate forms such as in hinges. PP and PE material lack transparency even after polishing. Also these material lack intensity, and are not suitable for goods that bear heavy burden. Also PP material changes color when exposed to radiation rays and the quality deteriorates. PS has weak shockproof property, and breaks when dropped. PET has had bad fluidity (molding feature) and was not suitable for injection molding.

[0015] In cases of disposable physics and chemistry experiment apparatuses with lids, the main body and the lid usually different parts or sold separately as in test tube caps.

[0016] There are only glass made slide glasses, but the edge of the slide is dangerous being sharp, and it breaks when dropped. There is no slide glass with lid cover, and when a cover glass is placed on top of a slide glass to sandwich the sample, the location of the sample tends to shift and the sample may spill over. Forming the round hollow part to place a sample on the slide glass is very expensive. There are no sterilized slide glasses.

[0017] When a pair of spectacles is dropped, expensive lens breaks. Light-weight steel frames are deformed easily.

[0018] When embossed processing is done on window glass, expensive processing is necessary. Also a regular window glass break easily with a hammer and is not a preferable material in terms of crime prevention.

[0019] Light shades and tableware made of glass are weak against shock ,and are easily broken. Resin made shades and tableware lack the sense of high class.

[0020] When a skylight is to be made onto a rooftop, the roof tile of that portion is

removed to place aluminum frame glass, thus the elegance of roof tiles is lost. When placing a solar panel, the only way is to place it above the roof tiles, and this also spoils the elegant atmosphere of roof tiles.

[0021] ABS or PPS resin used for helmets are affordable and are suitable for mass production, but lacks shockproof property. PC material is expensive and is not suitable for mass production. Although PC material has hardness, it is easily broken when made into thin plate form.

#### **Summary of this invention**

[0022] To solve the above issues, this invention proposes goods made of modified PET resin material, wherein the fluidity is improved and injection molding made possible due to utilization of co-polymerization and compound technology, and to produce products which were considered to be impossible with conventional injection molding method. With this invention, there is more freedom in its design, enabling processed goods with high transparency and good shockproof property. The whole body of the item can be made of one solid mold method with a hinge, wherein the thickness of the hinge part is set to be more than 0.2 mm at the thinnest part, and the PET resin with high flexibility functions as a hinge.

[0023] This invention proposes the thinnest part of the hinge to be in a plate form with its thickness more than 0.2 mm, the thickness increasing from the peak line in a tapering form, and the plate made in a circle cylinder form. There could be one portion of the thinnest part of the hinge or multiple portions with the thinnest part. These hinges enable appropriate spring property, the main body and the lid can be made with solid mold method, providing transparent containers with smooth opening and closing features.

[0024] This invention is made into containers to contain and pack disposable medical apparatuses, which can pack the used apparatuses at times of disposal, the package can be sealed and be disposed. This container has sterilized paper, film, Tyvek and such sheet which can be sterilized, the sheet is placed at the top part of the main body wherein a used apparatus is to be contained, the sheets to be sealed with heat-seal procedure, a lid is closed from above, enabling air tightness and aseptic state. Furthermore, the whole part can be covered with bag-like package which can be sterilized, which is heat-sealed, enabling double packaging to provide further

air-tightness and aseptic state, assuring further safety.

[0025] Apparatuses used in physics and chemistry experiments such as test tubes, Messzylinder, liquid measure, beaker, petri dish, cup, blood collecting tube, disposable cell, reagent bottle, sediment tube, centrifuge tube, can be made with modified PET resin, made with solid mold method with lid connected to the main body, wherein the apparatuses can be sealed with the lid after content is placed inside, to proceed with the experiment or for storage. As PET resin is radiation proof, the apparatus can be handled after radiation sterilization.

[0026] When slide glass for placing samples for microscope observation and storage is made of PET resin made from injection mold method, a round hollow for placing the sample can be made on the surface of the oblong plate easily. With a hinge the slide can have a lid with which the slide can be sealed completely. The transparency is also high. Such a slide glass can be sterilized.

[0027] In cases of spectacles, the lens, the lens frame, and the side frame can be made with solid mold method with PET resin. The hinge of the lens frame and side frame are connected, with high flexibility and is light in weight. This can be mass produced at affordable cost.

[0028] When goods with hinges utilizing PET resin material is made of injection mold, the setting of the injection mold cylinder will be set at 240 to 285 degrees centigrade, the speed of injection to be set at low to middle speed, for molding.

[0029] Another method is to form a hinge with projection molding method, wherein the projected material is embossed with vacuum mold processing.

[0030] Window glass made of PET resin can have wave form or vertical combined deformed window or with patterns and designs, with embossed characters and other such ornamentation is possible with the specific features of injection molding. The window frame, the handle or the lock parts can be made together with the window glass in solid mold processing method.

[0031] Light shades and tableware made of PET resin have much freedom in the design aspect, with strong shockproof property, high transparency, does not deform with

heat, and are affordable.

[0032] Transparent roof tiles made of PET resin also have much freedom in the design aspect, with strong shockproof property, high transparency, enabling a skylight to be set on the roof tile. Also a solar panel can be inserted and molded.

[0033] Helmets made of PET resin have much freedom in the design aspect, with strong shockproof property, high transparency, enabling safe field of vision.

#### **Description of the preferred embodiments**

[0034] Hereafter, a description of the preferred embodiments of this invention is made in reference to drawings. Fig. 1 shows a container of a sterilized medical apparatus (a wire system for sternum suture). Gimlets for sternum piercing 1a and 1b are stored inside the main body part of PET resin container made of injection molding method. Wire 3 is stored around the gimlets 1a and 1b. Hinge 4 is made of a plate with thickness of 0.3 mm at the thinnest part, the main body and the lid are connected with the hinge 4 with solid mold method and can be opened and closed smoothly. The main body and the lid are molded in a state where the main body and the lid are open at 180 degrees. When the main body and the lid are closed, approximately 0.15 mm of the hinge breaks, and the remaining 0.15 mm obtains appropriate spring features. When the thickness of the hinge is set at less than 0.2 mm, the hinge breaks when opened and closed only once, but if the thickness is 0.3 mm, the hinge bears a few hundred times of opening and closing at 180 degrees when opened. After the gimlets are used, the gimlets are stored to the original position handled as contagious medical waste, lock 5 is locked and the container is sealed. As the transparency is high, the handling of used risky waste can be conducted easily. The sealant feature is high, with a strong shockproof property, with no concern of blood leakage or infection. As proposed in Claims 6 and 7, by providing Tyvek sheet with heat seal process on top of the main part of the container, the inside of the container can be sealed completely. By closing the lid on top of that, the air-tightness and the aseptic aspect can be improved. As the air-tightness is assured, radiation (gamma rays) sterilization is more suitable than ethylene oxide gas sterilization. As PET resin is radiation proof, this material does not deteriorate or change color though used for a long term. When the whole container is seal packed with a Tyvek bag, further air-tightness, antiseptic feature and safety can be assured.

[0035] Figure 2 shows a test tube with a cap utilized in physics and chemistry experiments according to Claims 3 and 4. PET resin is processed with injection mold method, main body 6 is connected as one with lid 7 via hinge 8. The thinnest part of hinge 8 has the thickness of 0.3 mm, the thickness increasing in a tapering form from the peak line. Main body 6 has a high transparency, and it is easy to confirm the sample visually. The lid can be closed easily, and the sealant feature is high. As this apparatus is made with solid mold method, mass production at affordable cost is possible. It is also possible to wrap and seal the whole apparatus with sterilized packaging, and have the apparatus as gamma rays sterilized apparatus.

[0036] Figure 3 shows an example of a slide glass according to Claims 5 and 6. This slide glass is made of PET resin made from injection mold, the main body 9 is connected as one unity in solid mold method with lid 10 via hinge 11. The thinnest part of the hinge has the thickness of 0.3 mm, wherein a plate of that thickness is formed into a cylindrical shape. Different from a glass material, the edge is smooth and safe. The slide does not break even when dropped. This has high transparency, and it is easy to confirm the sample visually. The hollow part 12 in the middle of the slide is to stabilize the sample. With lock 13, the slide can be sealed and stored easily and definitely. As the slide can be sterilized, the sample will not be infected with bacteria reproduction. As the slide is made of solid mold method, mass production as affordable cost is possible.

[0037] Figure 4 shows a pair of spectacles according to Claim 7. PET resin material is molded with injection mold, and the lens 14a, 14b and lens frame 15 are made as solid mold with side frame 16a, 16b via hinge 17a and 17b. The thinnest part of the hinge has the thickness of 0.3 mm, wherein a thin plate is made into a cylindrical form. As this is shockproof, the spectacles do not break so easily even when dropped. Lens 14 and 14b has high transparency as high as glass. This material is suitable for correction of vision impairment for far-sightedness and such disabilities of that are uniformed to some extent. This can be mass produced at affordable cost.

[0038] Other goods with hinges made of injection molded PET resin in medical field are; surgical tool case, medication box, pill case; in other fields; electric parts, tools, tool case, carrying case, briefcase, disc cases for CDs, DVDs and such.

[0039] As explained above, this invention can provide PET resin goods with hinge which is shockproof, has high flexibility, high transparency, made in mass production at

affordable cost. When made into a container for containing disposable medical apparatus, visual confirmation is easily done to confirm and dispose the risky content as the transparency is high. This invention can offer high sealant feature, strong against shock, and there is no concern for blood leakage or infection. When sterilized sheet is heat-sealed within the container, further air-tightness and antiseptic aspect is assured, and when the outside of the container is sealed with a Tyvek bag, further antiseptic aspect is obtained and also as the bag is not double fold, the external packaging is made compact, and the total medical waste volume can be reduced.

[0040] Apparatuses used in physics and chemistry experiments such as test tubes, Messzylinder, liquid measure, beaker, petri dish, cup, blood collecting tube, disposable cell, reagent bottle, sediment tube, centrifuge tube, can be closed and sealed after placing the content inside, with the lid which is made in solid mold method, for further experiment testing or for storage. As PET resin is strong against chemical substances, this material is suitable for all kinds of samples. As there is no need to purchase separate stopper or plug, this material can contribute to reduce experiment expense. As this material has high transparency, it is easy to confirm the content visually. As PET resin material is radiation proof, apparatus made of this PET resin can be sterilized with radiation, and can be used immediately for aseptic tests. This material has stronger shockproof property compared to glass, there is less concern for breakage.

[0041] When slide glasses are made of PET resin from injection mold, the slide glass for microscope observation of samples and for storage, a circular hollow for placing samples on the oblong slide surface can easily be molded. It is also possible to have a lid to be made in solid mold method sealing the lid. When erythrocytes are placed on the slide, the hollow will prevent the red blood cells from damage, and the natural state of the cells can be observed. Such slide has high transparency and has high visibility. When the slides are made as sterilized slides, there will be no concern for the risk of the patients' infection as the slide glass surface is placed directly on the patients' finger tip skin, and there will be no risk of bacteria on the slides. Such slides do not break easily even when dropped, and there is less risk of injury due to the edge of the slides. As the slides are made of solid mold method, mass production at affordable cost is possible.

[0042] When spectacles are made of PET resin made from solid mold method, enabling mass production at affordable cost. Spectacles for far-sightedness are suitable for mass production, as there is limited number of lens specs. These

spectacles do not break even when dropped, and are less susceptible for deformation. As the transparency is as high as glass, the visual capability of such PET resin made spectacles is high. Such spectacles are light in weight compared to metal frame spectacles, and as heat conductivity is low, there is less change in skin contact temperature when wearing.

[0043] Window glass made of PET resin enables many types of ornamentation such as wave pattern, vertical combination deformed window, or windows with other patterns and designs such as embossed characters. Also, when the window is made in solid mold method together with window frame, handle and lock parts, the expense can be lowered due to less parts cost and labor cost. Different from glass, such PET resin window would not break so easily with a hammer, and so it is suitable for crime proof. In cases of earthquakes and disaster, there will be less concern of injury due to glass fragments. As heat conductivity of PET resin is low, such window will be more comfortable in hot summer season, and there is less condensation in wintertime. As the transparency is high, such window material will not hamper the view.

[0044] Light shades and tableware made of PET resin have high freedom in the design aspect, with strong shockproof property, high transparency, does not deform with heat, and mass production is possible at affordable cost. Compared to glass, PET resin material is light-weighted, and as the heat conductivity is low, less heat from light shades are conducted even in hot summertime. In cases of tableware, PET resin material is good for keeping warm food, and also easy to carry. Cold food kept in PET resin tableware would not get warm, and the surrounding do not condensate so much as other material.

[0045] Transparent roof tiles made of PET resin have much freedom in the design aspect, with strong shockproof property, high transparency and therefore a skylight can be placed within the roof tile. Heat insulation effect in summertime is also high. Also power generation type solar panel can be inserted and molded. As transparency is high, solar heat can be absorbed in solar panel effectively. As PET resin material has high shockproof property, there is less concern of breakage.

[0046] Helmets made of PET resin have high freedom in designing, good shockproof property, high transparency, and safe and wide angle view.

**Brief description of the drawings**

[0047] Fig. 1 is an explanatory drawing of an embodiment of a disposable medical apparatus made of PET resin.

[0048] Fig. 2 is an explanatory drawing of an embodiment of an experiment test tube with a cap, made of PET resin.

[0049] Fig. 3 is an explanatory drawing of an embodiment of a slide glass with a lid, made of PET resin.

[0050] Fig. 4 is an explanatory drawing of an embodiment of a pair of spectacles made of PET resin.